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Evaluation of Soil Moisture and Potassium Fertilization Levels on the Activity of Root-Knot Nematode (*Meloidogyne incognita*) Infecting Tomato Plant under Greenhouse Conditions

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ABSTRACT

The current study was carried out to assess the effect of different soil moisture levels i.e., 20, 40, 60, 80 compare to 100% of soil field capacity (FC) and potassium fertilization (KF) on final nematode population (Pf) and reproduction factor (RF) of root knot nematode, *Meloidogyne incognita* on tomato plant, *Solanum lycopersicum* L.(cv. Elisa). Results showed that of 20, 40, 60% FC significantly decreased tomato growth parameters compared to 100% FC control treatment. Moreover, the results indicated that the Pf and RF were significantly decreased at soil moisture levels of 20,40,60 and 80 compared to 100% level. The 80% FC level caused minor reduction in fruit fresh weight while significantly reduced nematode infection parameters (Pf and RF) compared to 100% soil moisture level control treatment. On the other hand, application of K-fertilization at every soil moisture levels enhanced the increase in all tomato growth parameters and reduced all nematode infection parameters. All studied tomato plant physiological parameters i.e. relative water content (RWC), cell membrane stability (CMS) and chlorophyll content were decreased as a result of decreasing soil moisture levels from 100 FC to 20% FC. In contrary, results showed that proline content in tomato plants was increased due to the decrease of soil moisture levels. Thus, soil moisture levels of 80% FC or 60% FC combined with high application rate of potassium (96 kg/fed) can be used to manage root- knot nematode *M. incognita* infection without negative effects on tomato crop growth attributes.

Keywords: soil moisture, potassium fertilization, root-knot nematode, *Meloidogyne incognita*, tomato plants.

INTRODUCTION

Root-knot nematodes, *Meloidogyne* spp. are obligate endoparasites, complete greater part of the life (RKN) cycle inside hostel plant and parthenogenetically reproduced by mitotic division. There are more than 2000 plant species, attacked by *Meloidogyne* spp. Root- knot nematodes (RKNs) are responsible for 12-30 % yield loss of the major crops worldwide. They are mainly distributed under warmer, tropical as well as subtropical regions, which the climate conditions are suitable for reproduction (Trudgill and Blok, 2001; Abad et al., 2003). Formation of root galls by root–knot nematode increases wilting and reduce growth, nutrient and water uptake results in deficiency of nutrients and low yield. Global tomato production effecting by the genus *Meloidogyne*, the most economically important nematode, which reduce yield by about 30-50% (Jonathan et al., 2001). Root knot nematode (RKNs) cause about 20-33% yield loss of tomato while nematicides cost more than 37$ million (Aalders et al,2009). Plants infected

by root-knot nematodes have stunted growth and low yield and quality (Khyami-Horani and Al-Banna, 2006).
Soil moisture is an important factor effecting nematode development and infection (Hunter, 2000) Root- knot nematodes can survive in soil for years but survival diminish quickly in soil subject if soil is subjected either too wet or too dry (Towsn and Apt., 1983). Karssen and Moens (2006) pointed out that water is needed for hatching process of *Meloidogyne* spp. as it regulated by temperature and moisture. Sasser et al. (1983) reported that worldwide water stress ensures that nematodes remain confined to both irrigated as well as highly rained agricultural areas. For coping with water shortage under arid and semiarid conditions, deficit irrigation levels, with water application below that of full field capacity is used. Such application management is an important tool which can achieve reducing the amount of water (Fereres and Soriano, 2007). Under dry conditions, soil moisture below field capacity is could be as a sustainable agricultural production (Geerts and Raes, 2009). On the other hand, low soil moisture content could use to control soil moisture – sensitive plant pests and diseases Mohwesh and Karajeh, 2014; Maareg et al., 2018). Mohwesh and karajeh (2014) found that soil water at a rate of 80 and 60 % can control root– knot nematode, *M. javanica* in tomato and eggplant. Mohawesh and Karajeh (2014) found that increasing water stress decreased soil water reduced the percentage of eggs hatching and increased second stage juveniles mortality of *M. javanica*. Shin (2005) . indicated that lowering deficit irrigation can be utilized to control some pests and disease, which are moisture –dependent as an extra benefits. Maareg et al. (2018) found that the final nematode population (PF) and reproduction factor (RF) of root-knot nematode, *M. incognita* were significantly decreased at soil moisture levels (FC) of 25 and 75 % than 100 % level, also the treatment of 75% level succeeded in the management of root-knot nematode without significant reduction in crop yield.

On the other hand, it is widely thought that adequate potassium nutrient for plants help in reducing the incidence of disease due to increased resistance to the penetrations and development of pathogens (Huber and Arny, 1985). The increase of plant resistance under such conditions is mainly due to the increased thickness of the epidermal cell wall boosting the structural rigidity of tissues. In addition, potassium fertilization may facilitate osmatic adjustment, which maintains turgor pressure at lower leaf water potentials and improves the ability of plants to face water deficiency stress (Mengel and Arneke, 1982; Lindhauer, 1985).

The current study aimed to evaluate the effects of soil moisture and potassium fertilization levels on tomato plant growth attributes and root- knot nematode, *M. incognita* reproduction parameters.

MATERIALS AND METHODS

The current study was conducted during growing seasons of 2021-2022 to compare the effects of different soil moisture levels (20, 40, 60, 80, 100%) field capacity (FC) and potassium fertilization rates of zero, 48 and 96 kg/fed in the form of potassium sulfate (48% K_2O) on tomato plants cv. Elisa infected with root-knot nematode, *M. incognita* under greenhouse conditions. Pots with a diameter of thirty centimeters were filled with solarized soil that was collected from the Experimental Farm of Faculty of Environmental Agricultural Sciences, Arish University, Egypt. Physicochemical properties of experimental soil are presented (Table 1).

The treatments consisted of five soil moisture levels and three potassium fertilization rates and their combinations hence, the total treatments were fifteen which replicated four times. Following a thorough mixing of soil with K fertilizer rates, thirty-day-old tomato seedlings cv. Elisa were transplanted with three seedlings per pot. During the first week, following tomato seedling transplantation, all pots received daily irrigation in an amount equal to 100 soil field capacity. Each pot was inoculated with a 10 ml suspension containing 2000 newly hatched second stage juveniles (J2s) of *M. incognita.*

. **Table 1:** Physicochemical properties of studied soil.

Parameters	Value
Physical parameters :	
Soil particle distribution(%):	
Coarse sand	83.21
Fine sand	3.23
Silt	11.63
Clay	1.93
Texture class	Loamy sand
Soil moisture constants %:	
Wilting point(WP)	1.85
Field capacity(FC)	7.73
Saturation percentage(SP)	18.20
Chemical parameters:	
PH	7.85
Electrical conductivity (EC) dSm^{-1}	1.76
Organic matter (OM),%	0.08
Water soluble ions, meq/l :	
Ca^{++}	4.69
Mg^{++}	2.81
Na^{+}	10.12
K^{+}	0.10
Cl^{-}	9.70
HCO^{-}□	4.50
CO_3^{--}	Nil
SO_4^{--}	3.51
N(mg//Kg)	0.37
P (mg/Kg)	1.21
K(g//Kg)	36.70

Fifteen days after seedlings transplantation, one seedling from each treatment was uprooted and number of penetrated nematodes was recorded according to Byrd et al.(1983). 105 days later, plants were carefully pulled out of the experiment and their roots were cleaned with tap water. Data of plant growth attributes were recorded. Females, and developmental stages/root system, as well as the number of J2s/250 g soil were counted according to Daykin and Hussey (1985) and Barker, (1985) methods. The final nematode population (Pf), reproduction factor (RF) were calculated using the following formulations: Final nematode population (Pf)= number of females/plant + number of developmental stages/root + number of J2s/pot. The reproduction factor (RF) was computed using the formula RF=Pf/Pi where Pi is the initial population and Pf is the final population (Norton, 1978).

Physicological and chemical constituents

Relative water content (RWC) was determined according to Galmés et al. (2007). Cell membrane stability (CMS) was measured by method described by Sairam et al. (1997). The content of proline was determined according to Bates et al. (1973). Chlorophyll content was determined according to Harborne (1984). N, P and K in tomato plants was determined according to Chapman and Prat (1982).

Data Analysis

Duncan's New Multiple Range Test was used to distinguish means at the 5% level of analysis for all data (Duncan,1955).

RESULTS AND DISCUSSION

Effect of soil moisture and K-fertilization levels on root-knot nematode activity

Obtained data in Table (2) revealed that all studied soil moisture levels and K fertilization rates significantly reduced all nematode parameters compared to control treatment. Results in Table (2) cleared that the reduction percentages in nematode penetration ranged between 10.93 and 38.82% at soil moisture levels of 80, 60, 40 and 20% FC. The highest reduction percentage of nematode penetration was obtained with 20% soil moisture level +96 kg/fed. fertilization (40.29). Developmental stages were also significantly affected by all soil moisture and K-fertilization levels. The lowest mean number value was obtained with the lowest soil moisture level of 20% combined with k fertilization (96 kg/ fed). Results revealed that high fertilization rate of 96kg/fed had the same effect on females which recorded the mean number value (86.50) at the lowest soil moisture level (20% FC).

Table 2: Effect of soil moisture and K fertilization levels on population density and reproduction factor of *Meloidogyne incognita* infecting tomato plants under greenhouse conditions.

Soil moisture (%FC)	K kg/fed	No. of penetrated juveniles	Red.* (%)	D.stages/ root	J2s /pot	Females /root	Pf	Red. (%)	RF
	0	208.50	----	2120.3	13927.5	352.0	16399.8	---	8.20
100	48	191.00	6.14	1866.3	13107.5	310.0	15283.8	6.80	7.64
	96	175.50	13.76	1615.0	12811.3	247.0	14673.3	10.53	7.34
	0	181.25	10.93	980.5	8531.5	243.3	9755.3	40.56	4.88
80	48	161.50	20.64	612.0	7318.8	236.0	8165.3	50.21	4.07
	96	141.00	30.71	318.0	7020.3	142.8	7481.0	54.40	3.73
	0	171.50	15.72	762.0	7719.5	210.5	8692.0	47.60	4.35
60	48	161.00	20.88	550.8	7201.5	181.5	7933.8	51.62	3.97
	96	138.25	32.06	332.0	6984.3	136.8	7453.0	54.51	3.73
	0	131.25	35.50	595.3	1761.3	100.8	2457.3	85.01	1.23
40	48	128.50	36.86	591.8	1748.8	94.3	2434.8	85.14	1.21
	96	126.50	37.84	590.0	1723.3	92.5	2405.0	85.43	1.20
	0	124.50	38.82	504.0	1211.5	90.8	1803.8	88.99	0.91
20	48	123.25	39.43	495.8	1201.5	88.3	1785.5	89.11	0.89
	96	121.50	40.29	489.5	1294.3	86.5	1770.3	89.21	0.89
LSD 0.05									
Moisture (%)		0.613		2.215	3.09	1.096	4.23		0.008
K		0.474		1.716	2.394	0.849	3.283		0.006
Moisture x K		1.062		3.83	5.35	1.899	7.342		0.014

Values are means of four replicates. *Reduction percentages of nematode penetration = mean number of penetrated juveniles in control treatment – mean number in the treatment /mean number of control treatment x100.

Also results in Table (2) revealed that the lowest soil moisture level of 20% combined with 96 K-fertilization rate resulted in the highest percentage reduction in Pf values which recorded

(89.21). In general, the lowest soil moisture levels from 80, 60, 40 and 20% resulted in the lowest nematode final population (Pf). Similar decrease effect was found in reproduction factor (Rf) with some different decreasing magnitudes. According to Watson and Apt (1983) the second-stage juveniles of *M. javanica* were mostly accumulated in the highest moisture content in the soil with a water film thickness that corresponded to the ideal mobility following their migration. Couch and Bloom (1960) reported that low soil moisture levels effectively controlled *M. hapla* populations and inhibit the mobility in the soil. Zhang and Schmitt (2001) reported that managing the amount of irrigation water may negatively affect the nematode development and root infection. According to Mohawesh and Karajeh (2014), the ability of *M. javanica* to reproduce in tomatoes and eggplants is significantly suppressed by deficit irrigation.

It is thought that adequate plant nutrition with potassium helps in reducing severity of diseases due to the increase of resistance to the penetration and development of pathogens (Huber and Arny, 1985; Perrenoud, 1990), in addition, Huber and Arny (1985) reported that potassium nutrient has the greatest influence on diseases by increasing the structural rigidity of tissue in many metabolic reactions in plants, as well as regulating stomata and promoting rapid recovery of injured tissue.

Table 3: Effect of soil moisture levels and K-fertilization on tomato growth parameters infected with *Meloidogyne incognita* under greenhouse conditions.

Soil moisture (%FC)	K-kg/fed	Shoot Length	Plant root length (cm)	Shoot weight (g)		Root weight (g)		Fruit fresh weight (g)
				Fresh	Dry	Fresh	Dry	
	0	55.33	39.35	293.00	73.25	96.30	31.20	375.23
100	48	65.53	33.68	305.15	78.85	111.43	37.43	531.08
	96	72.35	39.20	316.23	83.53	116.30	39.38	561.01
	0	54.43	28.58	290.88	71.83	97.53	29.53	521.08
80	48	63.48	31.35	302.00	77.65	109.20	34.35	529.02
	96	70.55	38.45	314.85	82.63	115.93	38.63	555.06
	0	44.13	20.40	266.95	60.40	83.65	22.23	481.07
60	48	53.80	24.20	275.05	64.58	89.38	24.28	491.08
	96	68.40	36.45	305.50	79.68	108.30	37.40	552.02
	0	32.28	14.23	234.50	51.35	65.60	17.43	335.09
40	48	33.50	15.25	235.73	52.40	66.20	18.20	340.04
	96	35.25	16.33	236.58	53.28	66.88	19.43	344.04
	0	22.60	12.30	191.08	32.03	41.08	14.15	223.08
20	48	23.85	12.80	192.78	32.93	42.35	14.48	227.04
	96	24.20	13.28	193.30	33.68	43.25	14.40	230.04
				LSD 0.05				
Moisture (%)	0.22	0.114	1.138	0.338	0.351	0.948	0.338	0.22
K	0.171	0.0883	0.882	0.262	0.272	0.734	0.262	0.171
Moisture x K	0.384	0.1974	1.972	0.587	0.608	1.642	0.587	0.384

Values are means of four replicates

Effect of soil moisture and K fertilization levels on tomato crop growth attributes

Obtained data (Table 3) revealed that soil moisture and k-fertilization levels have significantly effect on all tomato crop growth attributes. The lowering soil moisture levels from 80% to 20% FC resulted in the higher reduction of all studied growth attributes while the lowest reduction was at 80% FC. The fruit fresh weight at 20% FC was 223.08 g/plant comparing to 521.08 at 80% FC treatment. Application of K fertilization(96 kg/fed) at 80 % FC resulted in the highest fruit fresh weight which recorded 555.06 g/plant comparing to 230.04 g/plant at 20% soil moisture level. It worth to note that the fruit fresh weight at 80 and 60% soil moisture levels + 96 kg/fed k-fertilization were comparable with values of 555.06 and 552.02 g/plant. Furthermore, the obtained data in Table (3) cleared that soil moisture levels and K-fertilization have significant effect on all studied tomato growth attributes. The synergistic effects of K-fertilization was clear at both 80 and 60 % FC rather than 40 and 20% FC treatments.

Effect of soil moisture levels and K-fertilization on N, P and K content in tomato crop.

Data in Table (4) illustrate the effect of both soil moisture levels and K-fertilization on N, P and K content in tomato crop. Obtained data show that decreasing soil moisture levels from 80 to 20% FC resulted in decreasing in the content of all three nutrients in tomato crop. Soil moisture level of 80 % FC resulted N, P and K content of 4.41%, 333 ppm and 6780 ppm, respectively. Decreasing soil moisture levels to 20% FC recorded more decreasing of the nutrients which recorded 1.92%, 1.10 and 1220 ppm respectively. It is clear that adequate K-fertilization was important for increasing tomato k uptake. This is important, while availability of water is important since K reaches tomato roots by diffusion, K-fertilization shorting diffusion distance. Decreasing soil moisture level increases the path length of K to the root and can make K unavailable for plant in spite its high concentration in the soil (Barber, 1985). Addition of K fertilization at 96 kg/fed resulted in the highest values of N,P and K under all soil moisture level treatments.

Table 4: Effect of soil moisture levels and K- fertilization on N, P and K in tomato plant infected with root knot nematodes *Meloidogyne incognita*.

Soil moisture (% FC)	K- kg/fed	N %	P ppm	K Ppm
	0	4.76	340	7530
100	48	4.81	460	7680
	96	4.93	476	7801
	0	4.41	333	6780
80	48	4.69	350	6833
	96	4.73	352	6920
	0	4.92	310	5301
60	48	3.99	315	5360
	96	4.31	319	5390
	0	2.01	130	2220
40	48	2.20	136	2223
	96	2.23	139	2230
	0	1.92	1.10	1220
20	48	1.93	1.23	1226
	96	1.94	1.29	1229
LSD 0.05				
Moisture (%)		0.221	0.713	2.121
K		0.123	0.292	1.113
Moisture x K		0.362	1.401	3.721

Values are means of four replicates

Several studies show that K sprayed in drought stress conditions increased plant tolerance to various types of abiotic stress and increase growth and yield. Mengel and Kirby (2001) reported that K enhances physiological processes by regulating turgor pressure and photosynthesis, action transportation and enzyme activation. Meanwhile, Cakmak (2005) observed that plants suffering from drought stress, require more potassium. On the other hand, it is worth to note that in spite of adding K fertilization even at high studied rate under highly deficit moisture levels of 20 and 40% FC, there are little responses of that addition in terms of all studied tomato growth attributes. Such effects could be due to that K nutrient reaches to roots mainly via diffusion mechanism, and adding K fertilizer increases plant availability by shortening the diffusion distance (Barber, 1985).

The addition of K under such conditions influenced K uptake by plant, but water availability was important. Marschner (2011) and Kant and Kafkafi (2002) pointed to the importance of K fertilization on the biotic and abiotic tolerance of plant, in addition, irrigation water keeps cells turgid, which promotes cell growth and expansion. As an osmolyte, potassium is essential for osmotic adjustment (Marschner, 2011) a process in which solutes build up in plant cells in reaction to a drop in cellular water potential. This makes it possible to keep growing even with low water potential. Osmotic modifications have been shown to support stomatal conductance, photosynthesis, and leaf water content (Turner and Jones 1980; Morgan, 1984).

Osmotic adjustment and drought resistance are positively correlated (DaCosta and Huang, 2006). Overall, higher turgor pressure, relative water content, and reduced osmotic potential are maintained through improving osmotic adjustment which facilitated by sufficient K, which improves plant resistance to dry stress. Furthermore, maintaining a greater concentration of potassium in plant tissues encourages root growth by elongating roots (Akıncı and Lösel, 2012) which in turn increases the amount of exposed root surface area due to enhanced root water intake (Romheld and Kirkby, 2010). The importance of K in plant tissues encourage the ability to retain water during water stress (Lindhauer, 1985). K enhances the integrity of cell membranes (Wang et al., 2013), which often deteriorate under drought stress. In addition, potassium controls opening and closing of stomata. Rapid stomata closure and internal moisture retention are hence advantageous adaptation features in situations of water (Akıncı and Lösel, 2012). It is hypothesized that stomata closure will be made possible by an appropriate K+ concentration during a drought conditions.

Relative water content

Obtained data in Table (5) clear that ,leaf relative water content (RWC) was decreased with soil moisture decreasing levels. It was gradually decreased from 83.33 under 100 %FC level to 50.20 at 20% FC soil moisture levels, respectively. Addition of high fertilization rate of potassium recorded 85.20 % at 100 FC then declined to 50.35 at 20% FC soil moisture levels , respectively. Relative water content (RWC) is regarded as one of the most indictor for evaluating crop plant resistance to drought stress. Plant water status under different soil types and water regimes, crop species, irrigation schedule, and environmental conditions are all indicated by RWC. In the current experiment, RWC was low in tomato plant leaf tissues that was exposed to soil moisture stress. Plant water content (RWC) is decreased by drought stress (Nir et al., 2014). Munné-Bosch et al. (2003) found that a plant water status was indicated by a RWC value of 80%; are considered highly resistant for water stress while a plant with a RWC value of less than 50% was found to be severely stressed by a water deficit.

The relative water content of plants (RWC) is one of the most important indicators of water deficiency, as it is known to decrease during water stress conditions (Siddique et al., 2000). Research on the physiological alterations in drought-tolerant plants concerning water status during the early stages of growth reveals that these plants have high relative water content (RWC) and a high cell membrane stability index (CMS), which causes only slight damage to the cell membrane (Abbasi et al., 2014). Water limitation has an impact on plant growth and development. Li et al. (2011) showed that drought treatment significantly reduced the leaf relative water content. The leaf relative water content values decreased with increasing water stress. Leaf RWC is defined as the percentage of water present at the time of sampling, in relation to the amount of water in a saturated leaf (Tanentzap et al., 2015). Since RWC relates well with cell volume, it can accurately indicate the balance between absorbed water by plant and that lost though transpiration (Hassanzadeh et al., 2009), hence it is an important indicator of water status in plants.

Table 5: Effect of soil moisture levels and K- fertilization on physiological parameters of tomato plants infected with *Meloidogyne incognita*.

Soil moisture (%FC)	K-fertilization (kg/fed)	RWC%	CMS%	Proline (mg/g)	Chlorophyll (mg/g fw)
100	0	83.33	71.33	0.22	2.31
	48	83.95	73.18	0.23	2.71
	96	85.20	75.28	0.24	2.93
80	0	80.18	64.28	0.25	2.12
	48	81.28	66.50	0.27	2.51
	96	81.33	69.25	0.29	2.59
60	0	76.43	61.25	0.28	1.80
	48	77.20	62.55	0.33	1.92
	96	79.18	64.48	0.35	1.93
40	0	53.55	51.25	0.36	1.32
	48	53.58	52.25	0.38	1.32
	96	53.68	52.30	0.39	1.33
20	0	50.20	50.25	0.43	1.11
	48	50.35	50.28	0.44	1.13
	96	50.35	50.38	0.44	1.14
			LSD 0.05		
Soil moisture (%)		0.468	1.21	0.04	0.1
K		0.130	1.60	0.03	0.29
Soil moisture x K		0.591	2.71	0.06	0.31

Values are means of four replicates

Cell membrane stability

Obtained data in Table (5) revealed that cell membrane stability (CMS) recorded the high value of 71.33 at 100 % FC and declined to 50.25 at 20% FC treatment. Application of 96 kg/fed of K fertilization recorded the overall highest value of 75.28 at 100 % FC soil moisture level and decreased to 50.38 at 20 % FC soil moisture level combined with 96 kg/fed of potassium fertilization.

Proline content

According to results in Table (5) proline content in tomato plant was significantly increased by decreasing soil moisture. The, highest value of proline content (0.43 mg/g)was recorded at 20% FC soil moisture level treatment comparing to(0.22 mg/g) at 100% FC treatment. Addition of potassium fertilization high rate 96kg/ Fed resulted in (0.24 mg/g) of proline comparing to (0.44 mg/g) at 20 % soil moisture level treatment. Delauney and Verma (1993) reported that proline is synthesized from glutamic acid, acts as osmoprotectant for keeping the water content in cell plant under water stress conditions. Proline plays a role as compatible solute under all stress conditions. High content of proline could be, protecting cellular structures damage during soil moisture stress (Lehmann et al., 2010). In contrary to other studied physiological parameters, proline content in tomato plant was increased under soil moisture decreasing levels.

Chlorophyll content

Obtained data in Table (5) revealed that chlorophyll content (mg/g) in tomato plants was significantly decreased as a result of decreasing soil moisture level treatments.Soil moisture level of 100 % FC treatment recorded 2.31 mg/g then declined to 1.11 mg/g at 20% FC soil moisture level, respectively. Addition of potassium fertilization level rate (96 kg/fed) under high soil moisture level 100% FC recorded the highest chlorophyll content 2.93 mg/g then declined to 1.14 mg/ g at 20% FC soil moisture level treatment, respectively. Because of their vital role in the absorption of light energy, photosynthetic pigments continue to be key drivers of photosynthetic capacity in plants (Yuan et al., 2016).Water stress decreased chlorophyll content from being synthesized, (Montagu and Woo, 1999). Less chlorophyll content under water stress conditions could be due to plants adaptive approach involves reducing chlorophyll content to decrease the absorption of surplus energy (Elvira et al., 1998), or due to photo-oxidative damage caused by absorbing excess light energy (Powles, 1984).

CONCLUSION

The results of the current study showed that decreasing soil moisture levels can be beneficial to reduce nematode infection. Insignificant ($P \leq 0.05$) reduction in tomato crop growth attributes was observed at 80 % and 60% FC +96 kg/fed potassium fertilization while root – knot nematode infection parameters were significantly reduced ($P \leq 0.05$). In conclusions, decreasing soil moisture levels and potassium fertilization could be suitable to enhance the effectiveness of strategy to control *M. incognita* under limiting irrigation water resources conditions.

DECLARATION

The authors declare that they do not have any actual or potential conflict of interest.

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الملخص العربى

تقييم تأثيربعض مستويات رطوبة التربة والتسميد البوتاسى على مكافحة نشاط نيماتودا تعقد الجذور *Meloidogyne incognita* على محصول الطماطم تحت ظروف الصوبة الزراعية

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تتعرض الطماطم للعديد من المسببات المرضية خلال مراحل النمو المختلفة الفطرية والبكترية والفيروسية والنيماتودية . تهدف هذة الدراسة الى تقييم تأثيربعض مستويات رطوبة التربة والتسميد البوتاسى على بعض الصفات الخضرية والمرضية لمحصول الطماطم تحت ظروف الصوبة .تم استخدام معدلات رطوبة التربة ٢٠و ٤٠ و ٦٠ و ٨٠ ٪ رطوبة من السعة الحقلية للتربة مقارنة بالمعدل ١٠٠٪ سعة حقلية مع استخدم التسميد البوتاسى بمعدل ٤٨ و ٩٦ كجم / فدان . وامكن تلخيص اهم النتائج التى تم التحصل عليها فى الاتى : كان لمعدلات رطوبة التربة ٢٠و ٤٠ تأثير مع عدم وجود فروق معنوية بين معاملة ٨٠ ٪ و ٦٠ ٪ عند مستوى التسميد البوتاسى بمعدل ٩٦ كجم /فدان مما ادى الى انخفاض الصفات الخضرية للطماطم كذلك كان هناك انخفاض واضح فى العشيرة النيماتودية النهائية ومعدل التضاعف بصورة معنوية مع معدل رطوبة التربة ٨٠ و ٦٠ و ٤٠ و ٢٠ ٪ واوضحت النتائج ايضا اكبر انخفاض فى المعاملتين ٢٠ و ٤٠ ٪مستوى رطوبة التربة عند ٨٠ ٪ وكذلك عند ٦٠ ٪ مصحوبا بالتسميد البوتاسى ٩٦ كجم /فدان مما ادى ذلك الى تحقيق نقص كبير فى تعداد ومعدل تضاعف النيماتودا على محصول الطماطم بالمقارنة بالمعاملة ١٠٠٪ رطوبة تربة.اظهرت كل المؤشرات الفسيولوجية التى درست RWC,CMS و محتوى الكلوروفيل انخفاضا ملحوظا مع انخفاض المحتوى الرطوبى للتربة من ١٠٠ ٪ الى ٢٠ ٪ من السعة الحقلية. على العكس من ذلك ادى انخفاض مستويات رطوبة التربة الى زيادة ملحوظة فى محتوى البرولين فى نباتات الطماطم .و خلصت النتائج الى انه يمكن استخدام معدل رطوبة التربة عند ٨٠ ٪او ٦٠٪ +التسميد البوتاسى بمعدل ٩٦ كجم /فدان فى مكافحة نيماتودا تعقد الجذور والذى يعتبر ضمن عناصر المكافحة المتكاملة وذلك لتأثيرة المعنوى على خفض تعداد العشيرة النيماتودية فى الطماطم دون حدوث انخفاض معنوى وجوهرى فى المحصول مع توفير كمية مياة الرى خاصة فى المناطق التى تعانى من نقص المياه.